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of *Garrya rigida* and *G. fremontii*, and a host of others.

The genus *Rhamnus*, as represented on the Pacific slope, offers some excellent illustrations. *Rhamnus californica* of the coast ranges of central California has at least two very near relatives occurring in adjoining regions. *R. purshiana* of the northwest region and *R. tomentella* of the foothills of the Sierra Nevada and southern California. And, as we would naturally suspect, from the theory of isolation, the species occurring in central California is the intermediate one.

Ceanothus integerrimus (*C. andersoni*) of the Santa Cruz Mountains, *C. nevadensis* of the Sierra Nevada and *C. puberulus* of the San Bernardino Mountains are three very closely related species occurring in three different mountain ranges of the California province.

Adenostegia rigida of the coast ranges of central California, *A. filifolia* of southern California, and the Sierra Nevada form, not yet clearly defined, but bearing the name *A. rigida brevibracteata*, are, also, three very closely related species, clearly marked in the more isolated portions of their ranges, but apparently intergrading where the three ranges converge.

In southern California may be found other illustrations fully as conclusive. The flora of this region is naturally very similar to the more typical Californian flora, but it also has certain affinities with that of the Arizona region. Here occurs *Quercus engelmanni*, and it is in the Arizona region that we find its closest relative, *Q. oblongifolia*. Again, *Euphorbia palmeri* is represented in Arizona by *E. palmeri peplifolia* and *Ceanothus palmeri* by *C. myrianthus*.

The coastal and desert regions of southern California also present some well-marked examples. In this connection we need only suggest *Eriogonum fasciculatum* and *E. polifolium*, *Stenotus linearifolius* and *S. interior*, *Bebbia juncea* and *B. aspera*.

On the mesas about San Diego is the very common shrub, *Adenostoma fasciculatum obtusifolium*, which is wholly replaced northward by the typical form. Again *Calochortus*

weedii, also limited to the same general region, is replaced by *C. weedii purpurascens* in the vicinity of Los Angeles and Santa Barbara.

In the above illustrations it will be noted that the species selected are very closely related. Some may be inclined to criticize this and it may be argued that the plants mentioned are, at least in some cases, not distinct species. This we are perfectly willing to admit as plausible. They may be only subspecies; but they are, nevertheless, just as suggestive of the isolation theory.

We do not wish it understood, however, that we consider isolation the direct cause of the origin of species; but, whatever the cause, we do maintain that the evidence in favor of isolation as an important factor in the *perpetuation* of closely related species is almost overwhelming in plants as well as in animals. And any theory of evolution which will not allow for this fact can not possibly prevail.

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GROUND ROCK FOR FERTILIZING PURPOSES.

TO THE EDITOR OF SCIENCE: For several years the Division of Tests which is now attached to the Office of Public Roads has been investigating, in connection with the study of macadam road materials, the cause of the binding power of rock dust. These investigations have led to the conclusion that the decompositions that take place in rock powders under the action of water, when in a very fine state of subdivision (180-mesh and finer), and especially when the grinding has been done wet, bear upon a great many practical problems, some of which are of the very highest importance.

It appeared in fact that many of the feldspathic rocks which are more or less rich in potash might be made directly available as a fertilizing material. Although somewhat out of the line of experimentation of this office, under proper authorization the writer conducted a series of experiments on tobacco seedlings which showed that fine-ground orthoclase was very nearly, if not quite, as efficient as a source of potash plant food as the more

soluble potash salts which are in ordinary use. After these experiments were concluded the attention of the writer was called by Dr. F. K. Cameron to the fact that the value of ground orthoclase as a fertilizer had been pointed out by several investigators in the past, notably by Magnus in Germany (1850), Aitken in Scotland (1887) and by the Maine State Experiment Station and the Colorado Experiment Station (1889 and 1901) in our own country.

A paper is being prepared to be published in due time which will present all the information so far obtained upon this subject. This country is at present dependent upon foreign sources of supply for all the potash used annually for fertilizer by our farmers and growers, and in case of foreign wars, embargoes or reprisals, we should be cut off from a steady source of supply. The great stimulus that has been given by our growing cement industry to the art and economics of the milling of rocks to almost flour-fineness makes it possible to-day to consider the feasibility of grinding, not only some of our feldspar deposits, but even our richer potash-bearing feldspathic rocks, like some of the granites which we possess in unlimited quantities. To the proper solution of a problem of this kind it is necessary to enlist the interest and attention of men familiar with the economics of rock grinding and the handling and transportation of material in bulk, as well as of growers and experimental agriculturists. The object of this communication is to call attention to the interest and importance of the problem, and to open the field to all who are desirous of experimenting or of making actual use of ground rock for fertilizing purposes. ALLERTON S. CUSHMAN.

OFFICE OF PUBLIC ROADS.

SPECIAL ARTICLES.

ZIEGLER'S THEORY OF SEX DETERMINATION, AND AN ALTERNATIVE POINT OF VIEW.

IN his recent pamphlet entitled 'Die Vererbungslehre in der Biologie' Professor H. E. Ziegler proposes a new theory of sex determination. It was said even at the time of

Drelincourt that no less than 262 groundless theories of sex had been suggested; and it may be added that since that time there has been no falling off of interest in the sex question if the number of new theories proposed is a criterion.

Ziegler attempts to bring the question of sex determination under the prevailing view of specific chromosomal action. In recent years cytological speculation has largely rested on the assumption that the chromosomes are the sole bearers of the hereditary qualities. Hence all questions of inheritance have been referred to them, and in consequence their changes in the cell have attracted extraordinary attention. Many theories of heredity have been based on the shifting changes in the chromosomes alone. Their capacity for stains has greatly facilitated their study, while the rest of the cell that does not show much differentiation in staining capacity has been often ignored. Only in the case of the egg has the cytoplasm received anything like adequate treatment. The experimental work of Driesch, and of Wilson, in particular, has shown the important rôle that the cytoplasm plays in development.

Ziegler's primary assumption is that the chromosomes that arise from a female individual have a greater tendency to produce a female; and those that originate from a male individual have a greater tendency to produce a male. Since the child gets as many chromosomes from the father as from the mother, the parental chromosomes as such can not determine the sex. But it is to be recalled that amongst the parental chromosomes some have come from the grandfather and some from the grandmother. The relative number of chromosomes from the maternal and paternal lines will be variable in number on the current assumption that at the reduction division it is merely a question of chance which member of a pair of homologous chromosomes goes to one pole of the spindle, and which to the other. If the chromosomes of the grandfather predominate in the offspring it will be a male; if the grandmother chromosomes predominate a female develops.

To take an example. If the somatic num-